

# MARCH

March Instruments, Incorporated  
4057 Port Chicago Highway  
Concord, California 94520  
Phone: (510) 827-1240  
Toll Free: (800) 326-1151  
Fax: (510) 827-1189

## **OPERATION AND MAINTENANCE MANUAL**

***PX-2400***  
**PLASMA ETCHER**  
with microprocessor control

*Email:* [march@plasmod.com](mailto:march@plasmod.com), *Web Site:* [www.plasmod.com](http://www.plasmod.com)



# TABLE OF CONTENTS

UNPACKING .....	4
INSTALLATION .....	5
Facilities Requirements .....	5
Recommended Working Area Allowance .....	6
Connection .....	6
DESCRIPTION .....	8
Radio Frequency Power Generator and Matching Network .....	8
Process Controller .....	9
Reaction Chamber Module .....	9
PX Series Plasma Mode Configurations .....	12
PX Series Specifications .....	14
OPERATION .....	16
Process Completion: An Overview .....	16
Operators Sequence .....	19
Description of Controls and Indicators .....	20
Initial Startup Procedure .....	26
Calculating gas flow .....	27
Tuning .....	27
Shelf Configuration .....	28
Manual Operating Procedure .....	29
Automated Operating Procedure .....	32
SERVICE INFORMATION .....	35
Warranty .....	35
Service .....	37
Recommended Spare Parts .....	37
PX Series User Maintenance .....	38
Vacuum integrity .....	38
System Troubleshooting .....	40
Maintenance, Fault Isolation, Replacement and Adjustment Procedures, Auto tuning/Manual Tuning Circuits .....	45
APPENDIX .....	53
Effect of Operator-controllable Process Parameter Variation .....	53
PX Series Pump-down Speed .....	55
Independent Pressure Control Characterization .....	58
Glossary .....	62
NOTES .....	65
SCHEMATICS .....	

# UNPACKING

*ALL COMPONENTS OF THE PX-2400 PLASMA ETCHING SYSTEM ARE QUITE HEAVY. USE PROPER LIFTING PROCEDURES TO AVOID INJURY TO PERSONNEL.*

The PX-2400 Plasma Etcher is completely tested and inspected at the factory before shipping. Inspect all shipping cartons before unpacking the etcher. If there is any reason to suspect damage to the cartons or their contents, make note of the damage and report it to the shipping company immediately.

Unpack the shipping cartons carefully. The etcher is shipped in two containers:

- one containing the RF Power Generator.
- one containing the Process Controller and Reactor Chamber. These joined components are banded or bolted to the base of it's shipping pallet, then crated.

Vacuum pumps and other optional accessories are shipped in separate containers.

A packing list is included. Inspect the etcher and all other system components for any damaged or missing items.

If any component is damaged or missing, notify the shipper and notify the March Instruments Customer Service Department by telephone at (510) 827-1240 or by fax at (510) 827-1189 immediately. Claims based on late notification of shipping damage will be denied.

Keep all shipping containers and materials in case it should be necessary to return any item to March.

Place the system components on the selected work surfaces. Remove all packing materials including any that might be present in the chamber of the plasma etcher.

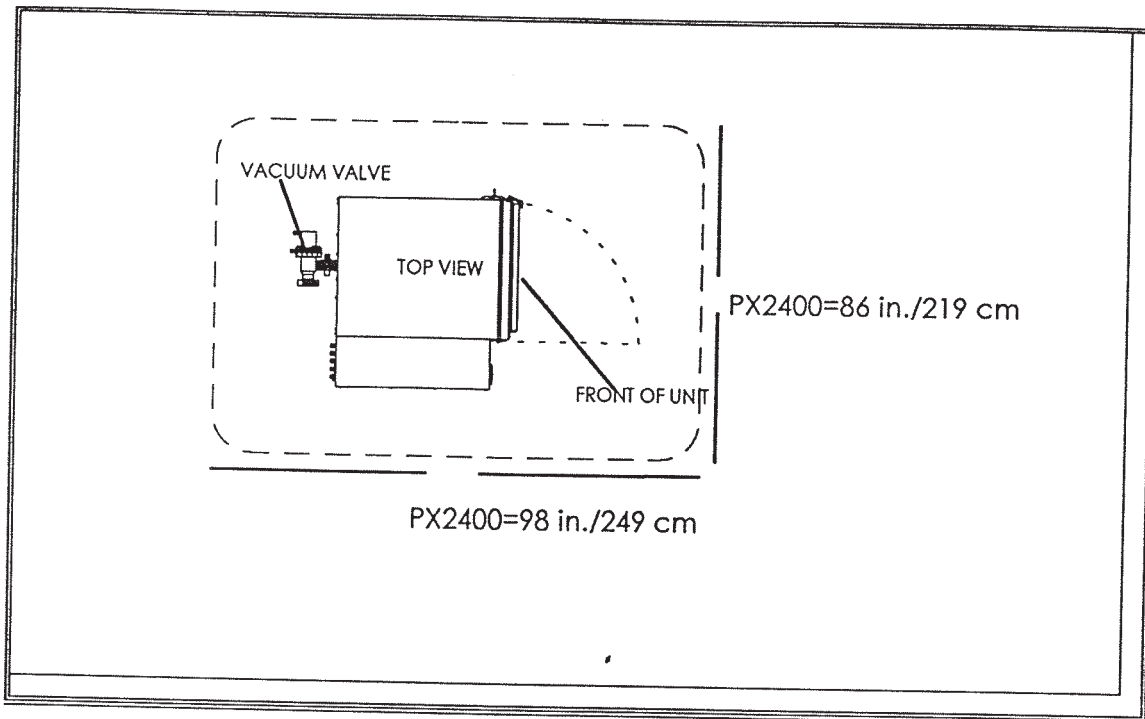
# INSTALLATION

## FACILITIES REQUIREMENTS

System Component	Specifications
<b>ETCHER</b>	
Power	110 or 220 VAC (specified at time of order), 20 Amps
Process Gases	Regulated to 10-15 PSI
Purge Gas	Nitrogen @ 40 PSI
External Gas Fittings	.25" Swagelok type
<b>VACUUM PUMP</b>	
Capacity	50 CFM
Lubricant	Charged with perflourinated, synthetic oil
Exhaust	2" ID Hose, Capable of 100 CFM flow
Power	50 CFM=230 VAC 3 Phase, 10 A
	Oil Filtration and Nitrogen Purge recommended for any Etcher used in a production application
<b>RF POWER GENERATOR</b>	
RF Level Capability	0-600 or 0-1000 watts
Power (supplied from rear of process controller module)	600 watt=115 VAC 50/60 Hz or 220 VAC 50/60 Hz, single phase. 1000 watt=220 VAC 50/60 Hz, Single phase

*NOTE: ALL CONNECTIONS BETWEEN PROCESS GAS SUPPLIES AND THE ETCHER MUST BE MADE USING CORROSION RESISTANT MATERIALS. ONLY TEFLON OR STAINLESS STEEL TUBING SHOULD BE USED. OTHER MATERIALS WILL CORRODE, GENERATING PARTICULATE MATTER WHICH WILL CLOG GAS SHUTOFF SOLENOIDS AND MASS FLOW CONTROLLERS.*

## RECOMMENDED WORKING AREA ALLOWANCE

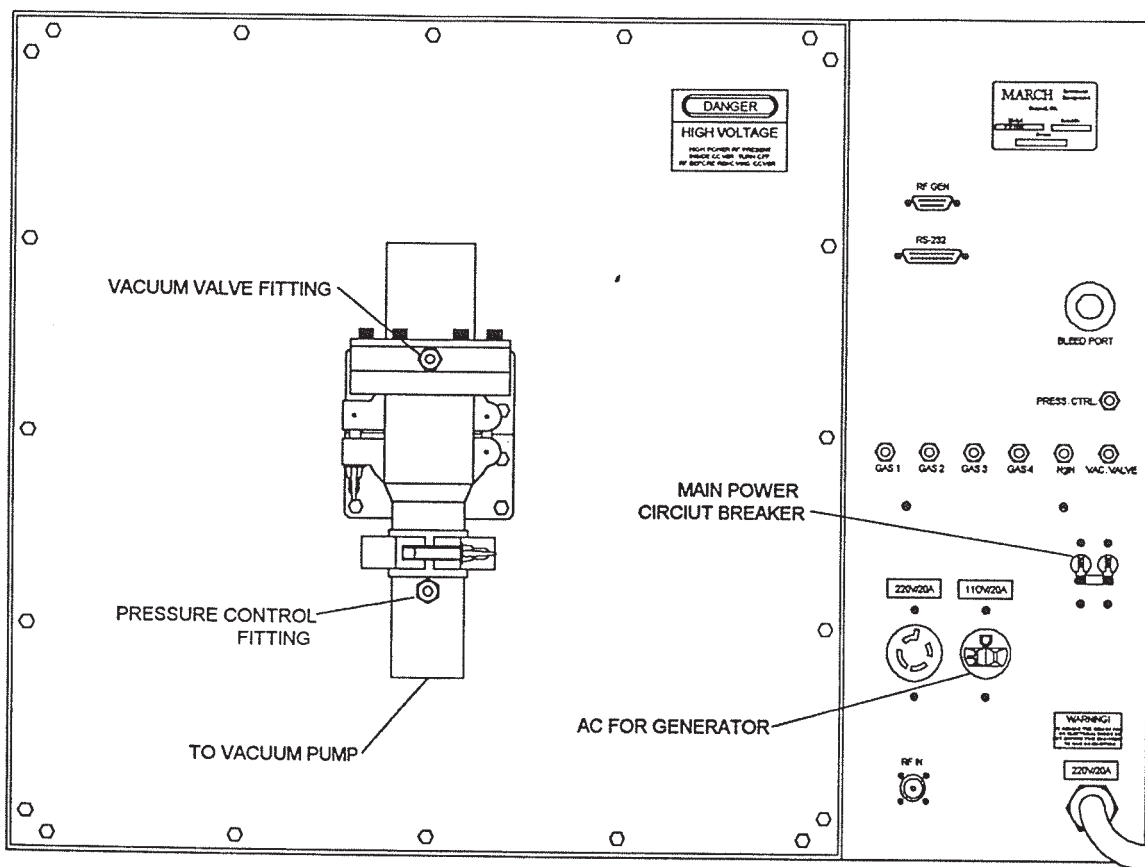


## CONNECTION

Please complete the following steps in listed order:

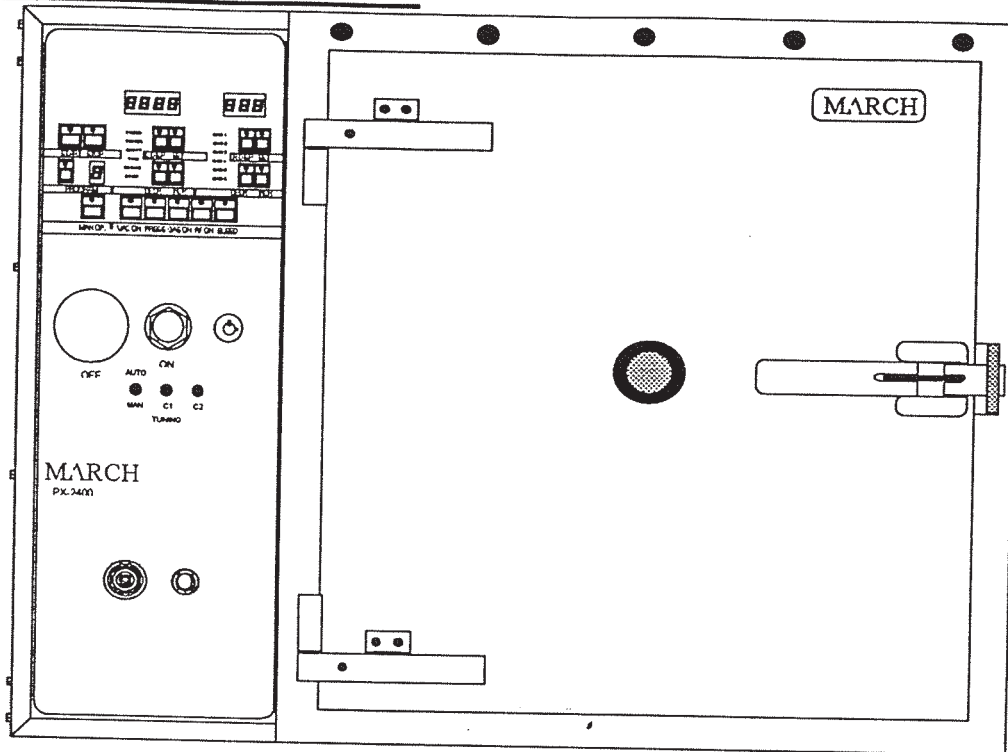
1. Connect vacuum valve and extension to chamber, (See appendix) Connect the vacuum pump to the vacuum valve using the hose and clamps provided. To ensure most rapid pump-down times, position pump as closely as possible to etcher but not on same surface.
2. Connect the Nitrogen purge gas line to the port on the Process Controller labeled "N2 IN."
3. Connect the desired process gases to the gas inlets on the Process Controller labeled "GAS 1," "GAS 2," etc., after ensuring that they are properly regulated.
4. Connect the vacuum valve compression fitting to the outlet on the Process Controller labeled "vac valve" using 1/4" tubing provided.
5. If Independent Pressure Control has been selected as an option, connect the port on the Process Controller labeled "PRESS CONTROL" to the fitting on the vacuum valve flange using the provided 1/4" tubing and fittings.
6. Check all gas connections.
7. Connect the RG8 cable between the BNC connector labeled "OUTPUT " on the RF Power Generator and the BNC connector labeled "RF IN" on the Process Controller.

8. Connect the data bus cable between the D type connector labeled "RF GEN" on the Process Controller and the D type connector labeled "USER" connection on the RF Power Generator.
9. Connect RF Power Generator power cord to electrical outlet on rear of Process Controller
10. -If RF Generator has water cooling, connect water cooling return and supply lines to it .
11. Connect system power cord to voltage source.
12. Connect Vacuum pump power cord to voltage source. Do not connect pump to electrical outlet on rear of Process Controller.
13. If a host computer is to be used for downloading process parameters or controlling the operation of the etcher, connect a serial communication line to the D type RS232 connector labeled ""RS-232" on the back of the etcher.



Rear View of PX Series Etcher

# DESCRIPTION



Designed for maximum performance and flexibility, March Instrument's PX-2400 Plasma Etching systems are large capacity etchers used for stripping, etching and cleaning applications. Unmatched in ease and breadth of configurability, the PX-2400 systems are easily and quickly switched from one process mode to another, including Direct, Downstream and Reactive Ion plasma etching.

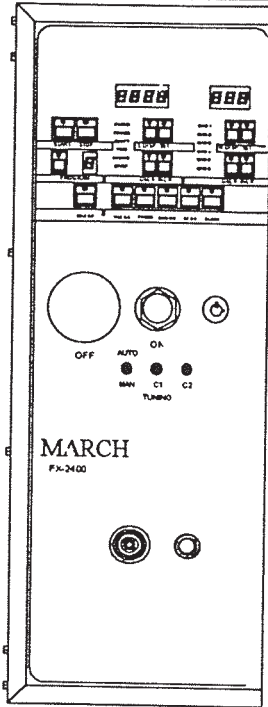
The PX-2400 Plasma Etcher consists of three modules: a Reaction Chamber, a Process Controller and a solid state RF Power Generator.

## RADIO FREQUENCY POWER GENERATOR AND MATCHING NETWORK

The PX-2400 etcher is equipped with a solid state generator with a fixed frequency of 13.56 MHz. Utilization of this frequency increases speed and uniformity of etching. Impedance matching is achieved through the employment of an Inductive-Capacitive tuning network, manually operated to achieve the best power transfer to the plasma by monitoring and adjusting the forward to reflected power ratio during processing. An automatic impedance matching network provides automated tuning for hands-off operation and convenience. The generator is remotely controlled and monitored by the Process Controller. For more information on the specific RF Power Generator, supplied with your system please see the technical documentation accompanying it.



## PROCESS CONTROLLER



The Process Controller monitors and regulates the variable parameters of the plasma generation process, including chamber base pressure, RF power level, duration and gases used and their flow rates. The Process Controller can house four Mass Flow Controllers (MFC'S); two are standard, two additional MFC'S are available as an option. The system is equipped with a Baratron pressure gauge for maximum accuracy.

The system can be operated in either an automatic or manual mode. In automatic mode built-in sequencing will:

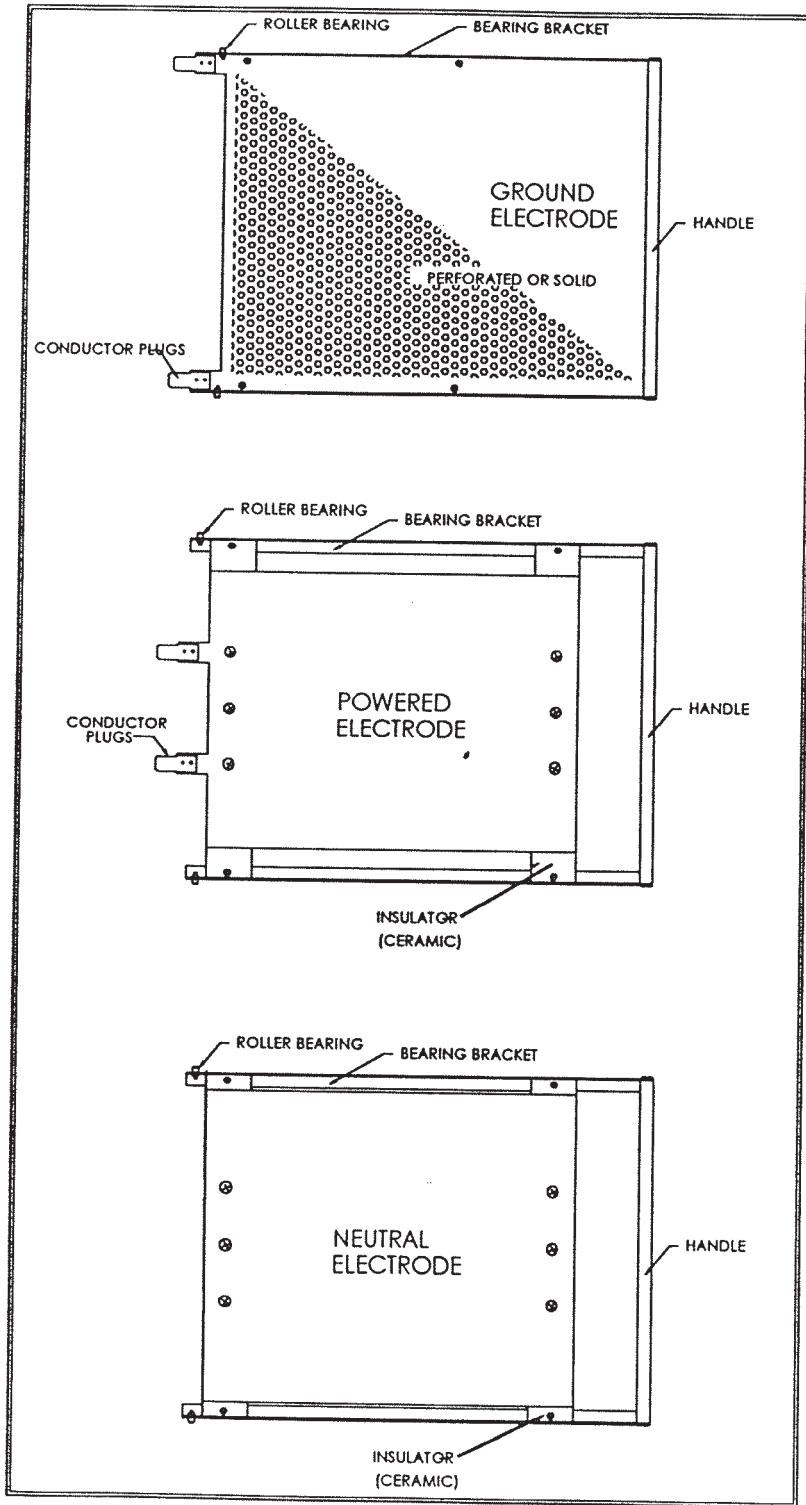
- Vacuum down the chamber to the preset base pressure level.
- Turn on the selected gases to the desired flow rate.
- Turn on the RF power to the desired level when the chamber pressure has equalized.
- Maintain these parameters until desired processing time has elapsed.

At the end of the initial process the controller will automatically switch to additional process steps (up to eight) if so programmed by the operator. Upon completion of the final process step, the Process Controller will perform a complete evacuation of process gases by pumping down to the preset base pressure. The end of process alarm will sound. The chamber can then be bled back to atmosphere by the operator. Manual mode provides the same control over process parameters but requires that each sequence step be initiated by the operator.

## REACTION CHAMBER MODULE

The front-loading chamber is equipped with sliding, roller mounted shelves for easy loading and unloading of samples. Easy reconfiguration of the PX-2400 is made possible by the ability to remove a shelf from one position and replace it in a different position or with a different type of shelf. The reaction chamber is accessed through a door equipped with a viewing window for observation of the plasma process. Chamber material is stainless steel; other components are manufactured from ceramic, Pyrex, aluminum and brass. No plastic or Teflon components are used in the construction of the chamber.

Page 1	Page 2	Page 3	Page 4	Page 5	Page 6	Page 7	Page 8	Page 9	Page 10	Page 11	Page 12	Page 13	Page 14	Page 15	Page 16	Page 17	Page 18	Page 19	Page 20	Page 21	Page 22	Page 23	Page 24	Page 25	Page 26	Page 27	Page 28	Page 29	Page 30	Page 31	Page 32	Page 33	Page 34	Page 35	Page 36	Page 37	Page 38	Page 39	Page 40	Page 41	Page 42	Page 43	Page 44	Page 45	Page 46	Page 47	Page 48	Page 49	Page 50	Page 51	Page 52	Page 53	Page 54	Page 55	Page 56	Page 57	Page 58	Page 59	Page 60	Page 61	Page 62	Page 63	Page 64	Page 65	Page 66	Page 67	Page 68	Page 69	Page 70	Page 71	Page 72	Page 73	Page 74	Page 75	Page 76	Page 77	Page 78	Page 79	Page 80	Page 81	Page 82	Page 83	Page 84	Page 85	Page 86	Page 87	Page 88	Page 89	Page 90	Page 91	Page 92	Page 93	Page 94	Page 95	Page 96	Page 97	Page 98	Page 99	Page 100
--------	--------	--------	--------	--------	--------	--------	--------	--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	----------



PX -2400 Work Shelves

## PX-2400 PLASMA MODE CONFIGURATIONS

Removable work shelves serve as the electrodes of the PX-2400 Plasma Etcher system. Shelf design of the PX-2400 enables maximum flexibility of process applicability by providing a simple means of configuring and re configuring the chamber interior for the various plasma modes detailed below.

### Downstream or Shielded Plasma

The downstream or passive plasma configuration is particularly appropriate for those samples which may be damaged when treated in a primary plasma. In this configuration, the plasma is generated between two electrodes and allowed to pass through the lower perforated electrode onto the sample. Because the lower electrode is grounded, the ions which normally can damage sensitive samples are trapped and only the remaining plasma can migrate to the surface of the sample, which rests on a neutral (not grounded or powered) shelf.

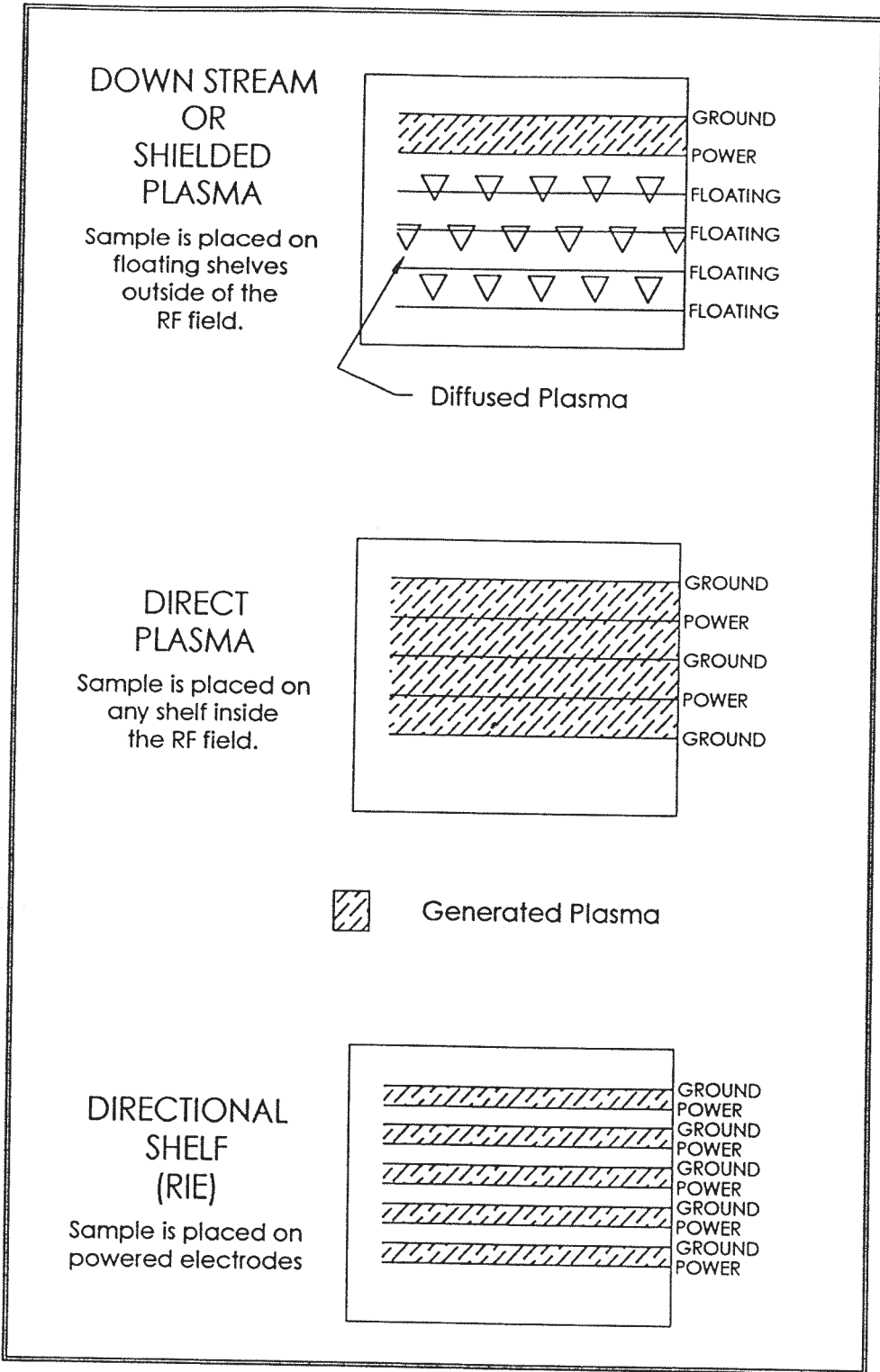
### Direct Plasma

This most common configuration is best for big parts or large quantities of smaller parts. This configuration provides a fairly aggressive plasma and places the sample between a powered and a grounded electrode. Up to ten shelves can be installed in this configuration giving the operator a total of 3200 square inches of working space in primary plasma in the larger PX-2400.

### Directional (Reactive Ion Etching)

The large anode to cathode ratio of this configuration provides for very fast, uniform, anisotropic etching. The size of the powered cathode can be specified by the user to accommodate specific geometry's and is well-suited for processing multi-chip modules, flat panel displays or other applications where selective profile etching is necessary. Up to four cathodes can be used in this unit at one time, giving the operator unparalleled throughput for large samples needing RIE processing.

Shelf spacing is variable in one inch increments.



Side view of work shelves in PX-2400 Etcher showing configuration for various plasma modes

## PX-2400 SPECIFICATIONS

### Exterior Dimensions

- 42" Wide x 48" High x 48" Deep

### Chamber Material

- Stainless Steel

### Chamber Interior Dimensions

- 28.25" Wide x 18" High x 31.5" Deep

### Weight

- 

### Maximum Number of Work Shelves

- Fourteen (14)

### Work Shelves Surface Area

- Power Shelf 24" Wide x 24" Deep
- Ground Shelf 24" Wide x 24" Deep

### Installation Working Surface

- Designed for use on table top or counter.
- Optional work stands available.

### RF Power Generator

- 0-600 or 0-1000 watt RF Power Generator available
- 13.56 MHz operating frequency
- Solid state circuitry
- Digital forward and reflected power display
- Automatic or Manual impedance matching
- Remotely controllable

### Process Controller

- Two or (optional four) Mass Flow Controllers
- Baratron (capacitance manometer) pressure gauge
- Microprocessor automated control with manual override
- Unlimited process recipe storage (using PC and optional Process Download software)
- Host Computer process initiation, monitoring and Termination (optional)
- Ability to lock-out parameter modifications
- Independent Pressure Control (optional)
- End of Process Alarm

### Safety

- Panel mounted Emergency Shut-Off turns off all power and gas flow, including RF Generator
- RF Generator interlocked if chamber pressure is out of range